DOCUMENT RESUME

ED 303 497 TM 012 725

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TITLE School District Variables as Predictors of Mathematics Achievement.
SPONS AGENCY Mississippi State Dept. of Education, Jackson. Bureau of School Improvement.
PUB DATE 88
NOTE 27p.
AVAILABLE FROM J. Reid Jones, P.O. Box 3115, Delta State University, Cleveland, MS 38733.
PUB TYPE Reports - Evaluative/Feasibility (142)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Achievement Tests; Elementary Secondary Education; Formative Evaluation; *Mathematics Achievement; Mathematics Curriculum; Mathematics Skills; *Predictor Variables; Problem Solving; *Profiles; School Demography; *School Districts; Scores; *Test Results
IDENTIFIERS *Mississippi

ABSTRACT

Progress in mathematics was evaluated for Mississippi, using data from all 154 school districts in the state. Focus was on determining the demographic context for mathematics achievement in Mississippi. Data from the 1986-87 District Profile Sheets compiled by the State Department of Education were analyzed. The Basic Skills Assessment Program tests in grades 3, 5, 8, and 11 and the Functional Literacy Examinations served as the dependent variables in this study. Summary statistics were obtained for 68 variables, including information on the county of residence, demographic and economic information on the school district, and average test scores of the district. Correlational and regression analyses indicated that economic factors and the educational environment of the district were the best predictors of mathematics achievement. The greatest difficulties in basic mathematics skills were: (1) computational skills beyond whole numbers in the elementary grades; (2) problem solving in the secondary grades; and (3) metric conversions in the elementary grades. The results for Mississippi were similar to, but somewhat lower than, those reported in the fourth National Assessment of Educational Progress. It is contended that Mississippi is fortunate to have tests keyed to the specific objectives in the state curriculum, making evaluation easier to conduct and more specific. Specific plans for progress can be developed from the determination of district variables associated with weakness or strength in mathematics. Five tables present study data. Objectives and an analysis of district profile sheets are appended. (SLD)

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SCHOOL DISTRICT VARIABLES AS PREDICTORS OF MATHEMATICS ACHIEVEMENT

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TM012725

School District Variables As Predictors of Mathematics Achievement

Society continues to evolve toward a more technological, information-based system. This premise has led to the widely held assumption that mathematics will play an increasingly important role in potential careers for today's students. Consequently, testing of mathematics schievement has become a popular topic in the educational research literature. Recent reports from the National Assessment of Educational Progress (NAEP) have emphasized shortcomings in mathematics conceptual development of American students, both at the elementary level (Kuoba, Brown, Carpenter, Lindquist, Silver, and Swafford, 1988) and at the secondary level (Brown, Carpenter, Kuoba, Lindquist, Silver, and Swafford, 1988). Since mathematics skills will also be important in an increasingly global economy, achievement scores inevitably will continue to be compared with those of other nations, particularly Japan. Generally, American students are judged poorly by comparison (Travers & McKnight, 1985). In an attempt to remediate these problems, the National Council for Teachers of Mathematics (NCTM) is presently revising recommendations for mathematics curricula. The new standards will place more emphasis on concepts and on the use of electronic calculators and computers, according to Thompson and Rathmell (1988).

The present report focuses on the demographic context for mathematics achievement in the state of Mississippi, where poverty levels are highest in the nation. Economic and school district (system) variables were found to create barriers to access in mathematics-related careers. Although patterns of achievement were similar to national trends, the level of mastery and conceptual development was found to be even lower than is generally true for this country.

On the brighter side, Mississippi has taken extensive steps to improve this situation. In 1982, the legislature passed the Education Reform Act. This law provided for the development of a state-wide curriculum in all content areas and for implementation of a performance-based accreditation system (Hebbler, 1985). Alabama has reported success with a similar approach (Hess, 1985). Morse (1986) has reported on the use of the Mississippi Model in instructional management. Amos (1986) has reported on initial evaluations of the system.

The Mississippi Model provides for a Basic Skills Assessment Program (BSAP) to test achievement of state curriculum objectives at grades 3, 5, 8, and 11. Additionally, 11th grade students are required to pass a Functional Literacy Examination (FLE). The mathematics objectives for these five tests are presented in Appendix A.

The relatively unique point of all this is that Mississippi's public schools have a common set of mathematics objectives, and that the basic skill objectives from that curriculum are tested annually. This approach provided achievement research advantages over those found in other states. Usually, the state mathematics curriculum (if one exists) is tested by using a nationally developed achievement series, such as the Stanford Achievement Tests. While these tests are excellent, scores cannot be specifically related to the unique set of mathematics objectives developed in each state. In Mississippi, achievement testing is more closely related to instruction. Children from both poor and wealthy homes are given the same mathematics objectives and then tested on those exact objectives. If a nationally normed test were used, based on somewhat different mathematics objectives, relationships to demographic factors could not be clearly assessed. Part of the achievement scores would undoubtedly favor children from higher socioeconomic (SES) backgrounds, as they are generally more broadly exposed to concepts and ways of thinking in other parts of the country.

If there are relationships between SES, educational level of the county, and ethnicity, they should show up more clearly in achievement test scores for states such as Mississippi. The BSAP tests at grades 3, 5, 8, and 11 and the FLE tests will serve as dependent variables in this research. Additionally, data will be presented concerning those types of objectives causing the most trouble for Mississippi school children. Finally, recommendations will be considered in light of recent NCTM proposals.

METHOD

Information on each of the 154 school districts in Mississippi has been systematically collected by the State Department of Education and summarized on District Profile Sheets (DPS). The present report analyzes data from the 1986-87 DPS. Table 1 presents descriptive statistics for these variables. Appendix B provides a detailed operational definition for each of the 68 variables. Several points should be made concerning Table 1. First, the number of observations ranges down to a low of 121 districts, although all 154 districts have reported for most of the 68 variables. Second, six of the variables (Population of County, Diploma % in county, Nonwhite % in county, College % in county, Income per capita in county, and Poverty level % in county) are based on reports from the 82 counties in Mississippi. Some of these county values had to be used twice to obtain an estimate for each of the 154 school districts. Thus, there is a failure of independence of observation for some of the cases in these six variables. A decision was made to use the non-independent observations for these six variables rather than lose that information. This issue is raised again when correlations and regressions are computed.

The variables fall into three broad catagories. First, the six county variables provide demographic information about the district. Second, 23 district variables (from Eleperc=percent students in elementary school to Stateper=percent funding from state sources) add further definition to the demographics of students, characteristics of the district, descriptions of teachers, and funding sources. All of these variables are based on statistically independent obeservations. Third, variables listing achievement test score averages for the district are presented (from BSAP 3 R to FLE Fail). A standard coding format is used throughout which first identifies the test (BSAP=Basic Skills Assessment Program; STA=Stanford Achievement Tests; FLE=Functional Lieteracy Examination). Second, the code identifies the grade level of the test (K=Kindergarten, 1=1st, etc.). Third, subtests are identified (M=Mathematics, R=Reading, W=Written Communication, C=Composite, L=Language, and E=Environment). Thus, the code name BSAP 3M refers to results on the Basic Skills Assessment Program for the third grade. Similarly, STA K L refers to results on the Stanford Achievement Test for Kindergarten on the Language subtest.

The Stanford Achievement Test scores for the first grade show a marked reduction in variability when compared to other test scores. The Project Director was concerned, and replicated this reduced variability in 1985-1986 data. Some problem in norms or scoring of the test must be responsible.

For correlational and regression analyses, the district average on each of the variables was used as the unit of observation. Thus, the total number of observations will usually be equal to the number of school districts (N=154). As previously mentioned, six of these variables do not provide independent observations for each district. They will be noted in tables of results. Regression procedures set mathematics achievement score as the dependent variable and employ a stepwise inclusion until the best model is achieved.

TABLE 1

DESCRIPTIVE STATISTICS BASED ON DISTRICT PROFILE SHEETS

STATE-WIDE STATISTICS
1986-1987

VARIABLE	MEAN	STANDARD DEVIATION	N
Type	1.74	.75	154
Population	40469.37	43239.54	154
Diploma	50.66	8.59	154
Nonwhite	37.42	17.95	154
College	10.77	4.26	154
Income	4807.32	757.46	153
Poverty	21.04	7.01	154
Eleperc	56.23	2.90	154
Permiddl	15.11	1.80	154
Persecon	27.17	3.33	154
Students	3135.71	3088.26	154
Vocedper	22.52	8.37	154
Gifted	3.06	2.21	121
Freelunc	72.76	18.09	154
Dropout	40.32	13.77	153
Stuteara	19.57	2.50	154
Elesal	17911.55	834.86	154
Seconsal	18522.18	849.29	154
Advdegre	40.73	10.12	154
Exp0to4	18.14	6.19	154
Exp5to9	21.33	4.66	154
Ex10to19	38.08	6.34	154
Ex20plus	22.21	6.89	154
Emercert	3.73	2.63	139
Outfield	4.37	4.94	134
Perpupil	1471.06	177.00	154
Advalore	338.92	265.96	154
Fedperc	17.82	5.74	154
Stateper	58.14	8.00	154
BSAP 3R	89.41	4.12	154
BSAP 3M	87.42	4.41	154
BSAP 3WRI	86.91	4.50	154
BSAP 3COM	379.92	6.24	154
BSAP 5R	80.91	5.50	154
BSAP 5M	77.97	5.48	154
BSAP 5WRI	79.45	4.61	154
BSAP 5COM	571.72	7.10	154
BSAP 8R	73.11	5.73	154
BSAP 8M	76.62	5.37	154
BSAP 8WRI	83.09	3.59	154
BSAP 8COM	869.20	6.41	154
BSAP 11R	81.59	5.33	153
BSAP 11M	76.73	5.26	153
BSAP 11WR	86.02	3.73	153
BSAP 11CO	1173.59	6.23	153
STA K READ	45.81	7.89	151
STA K MATH	45.81	6.52	151

Continued on next page

TABLE 1

STATE-WIDE STATISTICS
(Continued)

VARIABLE	MEAN	STANDARD DEVIATION	N
STA K LANG	No data avialable		
STA K ENV	49.14	8.02	151
STA 1 READ	48.62	2.30 *	152
STA 1 MATH	49.11	2.63 *	151
STA 1 LANG	No data available		
STA 1 ENV	51.81	2.47 *	151
STA 4 READ	47.14	7.30	151
STA 4 MATH	50.50	7.00	151
STA 4 LANG	50.81	5.96	151
STA 4 ENV	49.35	6.63	151
STA 6 READ	44.95	7.27	151
STA 6 MATH	47.74	6.09	151
STA 6 LANG	49.99	6.33	151
STA 6 ENV	No data avialable		
FLE READ	82.00	5.19	154
FLE MATH	74.46	6.79	154
FLE WRIT	88.84	2.79	154
FLE COMP	762.16	32.76	154
FLE FAIL	29.14	12.84	152
GOTO COLL	52.65	16.81	147

*Standard deviations for STA1 tests are markedly reduced when compared to other tests.

Finally, Principal Components Factor Analysis was used to evaluate the contribution of specific mathematics objectives to overall variation in mathematics achievement at each grade level. Again, district averages on each mathematics objective were used for each grade. Since all data were collected during 1986-87, all observations were taken on separate groups of students. Thus, the factor analytic results do not suffer from the lack of independence that affects a few of the regression and correlation results. Varimax rotation was completed for each of the four BSAP tests (grades 3, 5, 8, and 11).

RESULTS

Table 1 shows that most variables were based on a substantial number of district observations. Population in the county is noticeably non-normal in that the standard deviation exceeds the average. Teachers Out-of-Field also shows this defect. It should be noted that BSAP scores are based on percentage of correct answers, while Stanford Achievement Test scores are reported in terms of percentile averages for each school district.

Table 2 summarizes correlational results. Only significant correlations to BSAP and FLE Mathematics subtests are reported here. Two of the 68 DPS variables were omitted because of missing data (Emercert and Outfield). Also, Population was omitted because of its strongly non-normal distribution. Finally, those six variables based on non-independent county averages are asterisked if reported. Correlations are grouped in three categories: 1) Demographic Variables, 2) Previous tests, and 3) Concurrent Tests. The reason for separating 2) from 3) was that correlations for concurrent tests for a district are based on the same subjects during 1986-87, and correlations for previous tests during 1986-87 are based on different students at each grade level during that year of testing. The correlations for concurrent tests are understandably higher.

Generally, three trends are apparent from the correlations in Table 2. First, achievement tests at all levels are highly intercorrelated. This suggests that a general intellectual and/or motivational factor is playing the major role in achievement test results. However, it should also be remembered that these correlations are based on district averages in contrast to the more usual procedure of being based on individual student scores. Individual data may well yield a more specific pattern of intercorrelations and is presently being investigated.

Second, most of the correlated demographic variables are clearly related to either economic or ethnic factors. Closely related to the economic factors are variables dealing with the percentage of state and federal support for the districts. Percentage of the county population over 25 holding a high school Diploma is also strongly related to mathematics achievement. Finally, the Drop Out rate is clearly and negatively related to mathematics achievement scores.

Table 3 shows the results of stepwise regression analysis. Four county variables (Diploma Percent, Nonwhite Percent, College Percent of Population in the County, and Poverty Percent in the County) were selected from those variables previously noted as non-independent. This contamination of the first series of regressions seemed preferable to simply eliminating all county variables. Eleven district variables were selected (Number of students, Free Lunch Percent, Drop Out Percent, Student to Teacher Ratio, Average Elementary Salary, Average Secondary Salary, Four Levels of Teacher Experience including 0 to 4 years, 5 to 9, 10 to 19, and 20+, and Per Pupil Expenditure). Finally, all mathematics achievement scores from earlier grades were included at each level of testing (grades 3, 5, 8, and 11).

Five stepwise regressions were completed, setting BSAP and FLE Mathematics scores as the dependent variables. The results of these regressions are summarized in Table 3. All Multiple R's were highly significant, ranging from .50442 to .72186. Multiple R Squared, adjusted for shrinkage, was used as an estimate of the proportion of variance explained by the independent variables selected on the final regression step. The impact of economic factors is very strong at all levels.

TABLE 2

CORRELATES OF 3RD GRADE 1986-1987 BSAP MATHEMATICS PERFORMANCE

Complete Data Available on 147 of 154 Districts

DEMOGRAPHIC		
	**DIPLOMA	.2033*
	**INCOME	.3189**
	STATE PERCENT	.1964*
	NONWHITE	-.3999**
	**POVERTY	-.4293**
	FREE LUNCH	-.4712**
	DROP OUT	-.2177*
	EXP 20 PLUS	-.3314**
	FED PERCENT	-.3020**
PREVIOUS TESTS		
	STA K ENV	.3624**
CONCURRENT TESTS		
	BSAP 3R	.6462**
	BSAP 3W	.6796**
	BSAP 3C	.7680**

(* $p < .01$; ** $p < .001$)

(** Some observations not independent)

TABLE 2 continued

CORRELATES OF 5TH GRADE 1986-1987 BSAP IN MATHEMATICS

Complete Data Available on 147 of 154 Districts

DEMOGRAPHIC		
	**DIPLOMA	.2638**
	**INCOME	.3801**
	NONWHITE	-.3774**
	**POVERTY	-.4163**
	ELEPERC	-.2737**
	FREE LUNCH	-.5052**
	DROP OUT	-.2560**
	EXP 20 PLUS	-.3382**
	FED PERCENT	-.4149**
PREVIOUS TESTS		
	STA K MATH	.2498*
	STA K ENV	.3699**
	STA 4 READ	.5482**
	STA 4 MATH	.5789**
	STA 4 LANG	.5469**
	STA 4 ENV	.5058**
	BSAP 3R	.5268**
	BSAP 3M	.5050**
	BSAP 3W	.4979**
	BSAP 3C	.5723**
CONCURRENT TESTS		
	BSAP 5R	.7685**
	BSAP 5W	.7912**
	BSAP 5C	.8717**

(*p <.01; ** p <.001)

(** Some observations <u>not</u> independent)

TABLE 2, continued

CORRELATES OF 8TH GRADE 1986-1987 BSAP IN MATHEMATICS

Complete Data Available in 147 of 154 Districts

DEMOGRAPHIC		
	** INCOME	.3017**
	PERSECON	.2328*
	NONWHITE	-.3843**
	** POVERTY	-.3644**
	FREE LUNCH	-.5379**
	DROP OUT	-.2122*
	EXP 20 PLUS	-.2770*
	FED PERCENT	-.4580**
PREVIOUS TEST		
	STA K READ	.2010*
	STA K MATH	.2631**
	STA K ENV	.3591**
	STA 4 READ	.5166**
	STA 4 MATH	.5107**
	STA 4 LANG	.5385**
	STA 4 ENV	.5244**
	STA 6 READ	.5673**
	STA 6 MATH	.6093**
	STA 6 LANG	.5345**
	BSAP 3R	.4732**
	BSAP 3M	.4314**
	BSAP 3W	.4758**
	BSAP 3C	.5230**
	BSAP 5R	.6009**
	BSAP 5M	.5205**
	BSAP 5W	.5678**
	BSAP 5C	.6199**
CONCURRENT SCORES		
	BSAP 8R	.8263**
	BSAP 8W	.8271**
	BSAP 8C	.9246**

(* p < .01; ** p < .001)
(**Some observations not independent)

TABLE 2, continued

CORRELATES OF 11TH GRADE 1986-1987 BSAP IN MATHEMATICS

Complete Data Available on 147 of 154 Districts

DEMOGRAPHIC		
**	DIPLOMA	.2412*
**	INCOME	.3920**
	EXP 0 to 4	.2020*
	EXP 5 to 9	.2600**
	NONWHITE	—.5069**
**	POVERTY	-.4342**
	FREE LUNCH	-.6146**
	DROP OUT	-.2016*
	EXP 20 PLUS	-.3890**
	FED PERCENT	-.5426**
PREVIOUS TEST		
	STA K READ	.2857*
	STA K ENV	.2779*
	STA 1 ENV	.2448*
	STA 4 READ	.5223**
	STA 4 MATH	.5063**
	STA 4 LANG	.5670**
	STA 4 ENV	.5514**
	STA 6 READ	.6183**
	STA 6 MATH	.6540**
	STA 6 LANG	.5934**
	BSAP 3R	.4603**
	BSAP 3M	.3270**
	BSAP 3W	.3626**
	BSAP 3C	.4481**
	BSAP 5R	.6011**
	BSAP 5M	.4230**
	BSAP 5W	.5703**
	BSAP 5C	.5875**
	BSAP 8R	.6203**
	BSAP 8M	.4986**
	BSAP 8W	.6309**
	BSAP 8C	.6153**
CONCURRENT TESTS		
	BSAP 11R	.8337**
	BSAP 11W	.8432**
	BSAP 11C	.9220**
	FLE READ	.8249**

(* $p < .01$; ** $p < .001$)
(** Some observations not independent)

TABLE 2, continued

CORRELATES OF FUNCTIONAL LITERACY EXAMINATION IN MATHEMATICS FOR 1986-1987

Complete Data Available on 147 of 154 Districts

DEMOGRAPHIC		
**	DIPLOMA	.2512*
**	INCOME	.3934**
	EXP 0 to 4	.2591**
	EXP 5 to 9	.2455*
	NONWHITE	-.5543*
**	POVERTY	-.4385**
	FREE LUNCH	-.6334**
	DROP OUT	-.2221*
	EXP 20 PLUS	-.4211**
	FED PERCENT	-.5601**
PREVIOUS TESTS		
	STA K READ	.2171*
	STA K ENV	.2484*
	STA 1 ENV	.2229*
	STA 4 READ	.4832**
	STA 4 MATH	.4948**
	STA 4 LANG	.5256**
	STA 4 ENV	.5527**
	STA 6 READ	.6222**
	STA 6 MATH	.6442**
	STA 6 LANG	.5580**
	BSAP 3R	.3752**
	BSAP 3M	.2967**
	BSAP 3W	.2886**
	BSAP 3C	.3730**
	BSAP 5R	.6100**
	BSAP 5M	.4259**
	BSAP 5W	.5481**
	BSAP 5C	.5796**
	BSAP 8R	.6425**
	BSAP 8M	.5055**
	BSAP 8W	.6211**
	BSAP 8C	.6241**
CONCURRENT TESTS		
	BSAP 11R	.8320**
	BSAP 11M	.8993**
	BSAP 11W	.8262**
	BSAP 11C	.8901**
	FLE READ	.8353**
	FLE WRITTEN	.7414**
	FLE COMP	.9246**

(*p < .01; ** p < .001)
(** Some observations not independent)

TABLE 3

REGRESSION SUMMARY FOR MISSISSIPPI DEVELOPED MATHEMATICS ACHIEVEMENT TESTS AND DEMOGRAPHIC VARIABLES (STATE-WIDE)

DEPENDENT VARIABLE: MATHEMATICS TEST	MULTIPLE R*	MULTIPLE R^2 ADJUSTED FOR SHRINKAGE	INDEPENDENT VARIABLE	BETA	t	PROBABILITY
BSAP 3M	.50442	.24430	FREELUNCH	-.48349	-6.781	.0000
			ELESAL	-.16863	-2.365	.0193
BSAP 5M	.64059	.39824	STA 4 MATH	.34128	4.095	.0001
			BSAP 3M	.24439	3.212	.0016
			FREELUNCH	-.18245	-2.231	.0272
BSAP 8M	.62755	.38558	STA 6 MATH	.46995	5.772	.0000
			BSAP 5M	.21748	2.671	.0084
BSAP 11M	.69732	.47563	STA 6 MATH	.45466	5.460	.0000
			FREELUNCH	-.32052	-3.864	.0002
			STUDENTS	-.12725	-2.081	.0392
FLE-M	.72186	.50787	STA 6 MATH	.41468	5.135	.0000
			NONWHITE	-.16694	-1.924	.0564
			STUDENTS	-.14991	-2.513	.0131
			FREELUNCH	-.25306	-2.452	.0154

*All F tests for regression highly significant ($p < .001$)

In fact, economic factors (e.g. Percent on Free Lunch) are often better predictors of mathematics achievement than are previous mathematics achievement scores!

Table 4 shows the specific objectives, by grade level, which were most frequently missed on the basic skills tests. Three categories of problems may be noted. First, at Grade 5, students seem to be having trouble with computational skills which are more detailed than whole number operations. Second, while this problem persists at Grade 8, Problem Solving issues are generally more important difficulties. The third category, metric relationships, tends to show up mostly in Grades 3 and 5.

Table 5 shows the results of a Principle Components Analysis (Varimax Rotation) for basic skill objective performance at grades 3, 5, 8, and 11. A large, general factor emerges at each grade level, accounting for at least 50% of the variance at that level. Objective numbers refer to the list in Appendix A. At Grade 3, the general factor was named Mathematics Knowledge, owing to the wide variety of specific bits of information required to correctly answer the various objectives. A second factor was named "Applications" and a third factor was named "Computational Skill". The three factor model seemed to provide the best explanation, despite the much lower Eigenvalues of Factors 2 and 3. Survey of the objectives included in these latter Factors shows that there is little overlap with objectives contributing to Factor One. A cutting score of .40 was used throughout.

At the 5th Grade, the general factor was named Computational Skill With Whole Numbers, while two other factors made minor contributions (Metric Applications and Computational Skill With Fractions). At the eighth grade, the general factor was Computational Skill with Fractions and Decimals with a second, minor contribution from Word Problem Applications. Finally, at the 11th Grade, the general factor was Computational Skill with Details (Fractions, decimals, mixed numbers, etc.). A second contribution was labeled "Problem Solving".

DISCUSSION

Economic variables were shown to have a major impact on mathematics achievement scores in Mississippi. Other variables were also contributors to the low achievement levels including low percentage in county with high school Diploma, high Drop Out Rate, and Percent NonWhite. Stepwise regressions led to final models which were based on previous achievement test results and economic variables for the district.

By providing all schools with the same curriculum objectives and testing on those objectives, the Mississippi system of performance evaluation amounts to what has been called "objective referenced testing" on a state wide basis. The advantages of this approach seem clear with regard to evaluating the impact of economic and demographic variables. In other states, it is reasonable to assume that school districts with very high socioeconomic status also have a better developed curriculum. Further, nationally normed achievement tests do not provide the specificity of detail in relating objectives to achievement as has been the case in this report.

Both analysis of errors (Table 4) and factor analysis (Table 5) suggest that computational skills are emphasized by the Mississippi system of objectives and testing. This needs to be evaluated in light of the recommendations made by Thompson and Rathmell (1988). Leinhart (1988) argues that students have considerably more "intuitive" grasp of mathematics concepts than most teachers or tests are prepared to accept. Certainly the BSAP test would not reflect much of this. However, there are great advantages to the specificity of feedback available from the testing procedure. Additionally, materials developed for the state-wide program in one district can be shared with less successful districts and keyed to state wide achievement testing. In fact, this is one outcome of the present contract that is currently being implemented.

TABLE 4
MATHEMATICS OBJECTIVES CAUSING THE MOST PROBLEMS
BY GRADE: 1986-1987 STATEWIDE

	BSAP OBJECTIVE	APC*	SD	DESCRIPTION
GRADE 3	5	75.488	8.52	----- Identify Fractions
	13	69.727	12.77	----- Select Units of Measure (metric)
	14	77.188	9.59	----- Make Change of $1.00
	16	79.541	9.66	----- Compare Calender Units
GRADE 5	2	72.925	13.78	----- Rounding of Numbers
	3	75.699	17.70	----- Convert Improper Fractions
	4	67.767	13.89	----- Simplify Proper Fractions
	9	72.699	11.39	----- Divide by Multiples of 10
	10	78.451	11.85	----- Add fractions and Convert
	13	58.83	12.79	----- Metric Relationships
	14	44.11	12.65	----- Metric Relationships
GRADE 8	2	74.231	11.66	----- Identify Equivalent Fractions
	5	62.289	13.29	----- Operations Involving Fractions
	9	72.728	7.09	----- Word Problems with whole numbers
	10	67.931	9.55	----- Word Problems with Fractions
	11	46.706	9.10	----- Word Problems with Percent
	12	65.192	8.18	----- Word Problems with Time
	13	74.827	7.52	----- Interpreting Graphs
GRADE 11	1	58.997	10.64	----- Rounding and Estimation
	5	64.767	10.80	----- Operations with Mixed Numbers
	8	76.699	8.72	----- Find Area, Given Formula
	10	62.132	11.13	----- Word Problems with Fractions
	12	42.610	7.56	----- Interpret Graphs
	13	78.725	6.43	----- Interpret Graphs

*Average Percent Correct

TABLE 5

SUMMARY OF FACTOR ANALYSIS FOR BSAP TESTS

Definition of Factor Analysis: A statistical procedure that allows the investigator to take a large number of variables (eg BSAP 3 Mathematics Objectives) and group them into a smaller number of hypothetical variables (eg Mathematics Knowledge).

BSAP Mathematics - 3rd Grade:

Factor One: Mathematics Knowledge; 10 of 17 Objectives
Eigenvalue = 9.268; Variance Accounted For = 54.5%

Rank	Objective	Loading	Brief Description of Objective
1	3.1	.7457	Identify place value
2	3.2	.7387	Identify number words
3	3.13	.6848	Select measure length
4	3.3	.6825	Use symbols to compare
5	3.6	.6445	Add 3 digit numbers
6	3.11	.6089	Tell time to hour
7	3.7	.5501	Subtract 3 digit numbers
8	3.14	.5014	Make change for $1
9	3.16	.4995	Compare calander units
10	3.5	.4760	Identify fractional parts

Factor Two: Applications; 6 of 17 Objectives
Eigenvalue = 0.7392; Variance Accounted For = 4.3%
(Objectives by rank: 3.17, 3.16, 3.14, 3.15, 3.5, & 3.10)

Factor Three: Computational Skill; 6 of 17 Objectives
Eigenvalue = .4809; Variance Accounted For = 2.8%
(Objectives by rank: 3.8, 3.4, 3.9, 3.7, 3.6, & 3.12)

BSAP Mathematics - 5th Grade:

Factor One: Computational Skill (whole numbers); 8 of 16 Objectives
Eigenvalue = 9.6613; Variance Accounted For = 60.40%

Rank	Objective	Loading	Brief Description
1	5.7	.7914	Multiply 3 by 3 whole numbers
2	5.8	.7842	Divide by 1 digit whole number
3	5.11	.7554	Add & subtract decimals (100ths)
4	5.9	.6832	Divide by multiple of 10
5	5.6	.5939	Subtract 5 digit whole numbers
6	5.5	.5475	Add 5 digit whole numbers
7	5.16**	.5187	Metric-English Relations
8	5.1	.4400	Read & write numerals to million

Factor Two: Metric Applications; 8 of 16 Objectives
Eigenvalue = 1.0262; Variance Accounted For = 6.4%
(Objectives by rank: 5.13, 5.15, 5.2, 5.1, 5.12, 5.6, 5.14, & 5.16)

Factor Three: Computational Skills With Fractions; 5 of 16 Objectives
Eigenvalue = 0.70461; Variance Accounted For = 4.4%
(Objectives by rank: 5.4, 5.3, 5.10, 5.14, & 5.9)

TABLE 5
Continued

ESAP Mathematics - 8th Grade:

Factor One: Computation Skill (Fractions, Decimals); 10 of 14 Objectives
Eigenvalue = 9.3871; Variance Accounted For = 67.1%

Rank	Objective	Loading	Brief Description
1	8.5	.8006	Add & subtract fractions
2	8.10	.7625	Word problems with fractions
3	8.4	.7590	Whole numbers, basic operations
4	8.6	.7577	Decimals, basic operations
5	8.3	.6965	Simplify fractions
6	8.2	.6301	Identify equivalent fractions
7	8.11	.5879	Word problems with percent
8	8.9	.5617	Word problems with metrics
9	8.14	.5413	Complete a check stub
10	8.7	.5006	Simplify expressions (2+ steps)

Factor Two: Word Problems & Applications; 9 of 14 Objectives
Eigenvalue = 0.68900; Variance Accounted For = 4.9%
(Objectives by rank: 8.13, 8.9, 8.12, 8.14, 8.1, 8.8, 8.7, 8.10, & 8.2)

ESAP Mathematics - 11th Grade:

Factor One: Computation Skill (Details); 10 of 13 Objectives
Eigenvalue = 9.198; Variance Accounted For = 70.8%

Rank	Objective	Loading	Brief Description
1	11.10	.9012	Word problems, various
2	11.5	.8092	Operations on mixed numbers
3	11.4	.7508	Operations on fractions
4	11.8	.6950	Compute perimeter given formulae
5	11.2	.6719	Identify equivalent fractions
6	11.6	.6633	Operations with decimals
7	11.11	.6305	Word problems with percent
8	11.1	.5920	Round off numbers
9	11.12	.5640	Word problems with time
10	11.7	.5299	Equations with one variable

Factor Two: Problem Solving Skill; 8 of 13 Objectives
Eigenvalue = 0.5519; Variance Accounted For = 4.2%
(Objectives by rank: 11.9, 11.13, 11.12, 11.3, 11.7, 11.2, 11.8, & 11.6)

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APPENDIX A

MATHEMATICS - BASIC

3-1. Identify place value of a given digit in three- or four-digit numeral
3-2. Identify number words through thousands
3-3. Use <, >, or = to compare two numbers
3-4. Use the symbols +, -, ÷, ⌐‾ or x
3-5. Identify fractional parts from halves through fifths
3-6. Add through 3-digit whole numbers, regrouping as necessary
3-7. Subtract through 3-digit whole numbers, regrouping as necessary
3-8. Multiply using basic facts through 5 x 9
3-9. Divide using basic facts through 45 ÷ 9
3-10. Identify circles, triangles, rectangles, or squares
3-11. Tell time to the hour, half hour, or quarter hour
3-12. Measure length to nearest centimeter or inch
3-13. Select the appropriate unit of measure (English or metric) for problems involving length
3-14. Make change up to one dollar
3-15. Compare relationships among coins up to one dollar: pennies, nickels, dimes, quarters
3-16. Compare relationships among calendar units: days, weeks, months, years
3-17. Solve word problems involving whole numbers, using one of the basic operations

MATHEMATICS - BASIC

5-1. Read and write numerals through 1,000,000
5-2. Round numbers to nearest ten, hundred, or thousand
5-3. Change improper fractions to mixed numbers
5-4. Simplify proper fractions
5-5. Add up to four 5-digit whole numbers, regrouping as necessary
5-6. Subtract through 5-digit whole numbers, regrouping as necessary
5-7. Multiply through 3-digit by 2-digit whole numbers, regrouping as necessary
5-8. Divide by a 1-digit whole number divisor
5-9. Divide by a multiple of ten
5-10. Add two fractions with like denominators, renaming the sum as a mixed number or simple fraction; subtract two fractions with like denominators
5-11. Add with decimals through hundredths; subtract with decimals through hundredths
5-12. Tell time to the nearest minute
5-13A. Identify relationships between English or metric units of measure: capacity: pint, quart, gallon; or milliliter, liter
5-13B. Identify relationships between English or metric units of measure: length: inch, foot, yard; or millimeter, centimeter, meter
5-13C. Identify relationships between English or metric units of measure: weight: ounces, pounds; or grams, kilograms
5-14A. Identify relationships between English or metric units of measure: capacity: pint, quart, gallon; or milliliter, liter
5-14B. Identify relationships between English or metric units of measure: length: inch, foot, yard; or millimeter, centimeter, meter
5-14C. Identify relationships between English or metric units of measure: weight: ounces, pounds; or grams, kilograms
5-15. Determine weight to the nearest pound or kilogram; measure length to the nearest centimeter or quarter inch
5-16. Read temperature on Fahrenheit and Celsius scales
5-17. Solve word problems involving whole numbers, using one operation
5-19. Solve word problems involving money, using addition and subtraction
5-20. Interpret bar graphs, pictographs, or circle graphs

MATHEMATICS - BASIC

8-1. Round numbers to a specific place; estimate sum and difference of whole number computational problems
8-2. Identify equivalent fractions, decimals, and percents
8-3. Simplify any given fraction or mixed number
8-4. Add, subtract, multiply, and divide whole numbers
8-5. Add, subtract, multiply, and divide fractions; add, subtract, multiply and divide mixed numbers
8-6. Add, subtract, multiply, and divide decimals
8-7. Simplify expressions involving more than one operation
8-8. Measure temperature, length, capacity, or weight, using metric or English units
8-9A. Solve word problems involving whole numbers, using one or two operations
8-9B. Solve word problems involving decimals, using one or two operations
8-9C. Solve word problems involving money, using the basic operations
8-9D. Solve word problems involving metric or English units of length, weight, or capacity, using the basic operations
8-10A. Solve word problems involving fractions, using one or two operations
8-10B. Solve word problems involving mixed numbers, using one or two operations
8-11. Solve word problems involving percent, using one or two operations
8-12. Solve word problems involving time, using the basic operations
8-13. Interpret bar graphs, line graphs, pictographs, or circle graphs
8-14. Complete a check and its stub

MATHEMATICS BASIC

11-1. Round numbers to a specific place, and estimate answers to whole number computational problems
11-2. Identify equivalent fractions, decimals, or percents
11-3. Add, subtract, multiply, and divide whole numbers
11-4. Add, subtract, multiply, and divide fractions
11-5. Add, subtract, multiply, and divide mixed numbers
11-6. Add, subtract, multiply, and divide decimals
11-7. Solve equations involving one variable
11-8. Compute the perimeter and/or the area of any given triangle, or quadrilateral, given the appropriate formula
11-9A. Solve word problems involving whole numbers, using one or two operations
11-9B. Solve word problems involving decimals, using one or two operations
11-9C. Solve word problems involving money, using one or two operations
11-10A. Solve word problems involving fractions, using one or two operations
11-10B. Solve word problems involving mixed numbers, using one or two operations
11-11. Solve word problems involving percentages, using one or two operations
11-12. Solve word problems involving time, using the basic operations
11-13A. Solve word problems involving metric or English units of length, using the basic operations
11-13B. Solve word problems involving metric or English units of weight, using the basic operations
11-13C. Solve word problems involving metric or English units of capacity, using the basic operations
11-15. Interpret bar graphs, line graphs, pictographs, or circle graphs

MATHEMATICS - FUNCTIONAL

FL-1. Complete a check and its stub
FL-2. Calculate take-home pay when given hourly, weekly, or monthly wage and the deductions
FL-3. Calculate selling price when given list price, sales tax rate, and/or rate of discount on an item
FL-5. Calculate monthly payments over a specified period of time when given total cost
FL-6. Calculate the balance of a personal checking account when given initial balance, deposits, withdrawals, and service charges
FL-7. Compute the cost for food, shelter, clothing, savings, or other expenses, based on a given fractional or percentage portion for each expense, when given a weekly or monthly income
FL-8. Use estimation in everyday situations involving time, money, distance, weight, or capacity
FL-9. Measure time, temperature, distance, capacity, or weight

APPENDIX B

ANALYSIS OF DISTRICT PROFILE SHEETS

OPERATIONAL DEFINITIONS OF VARIABLES
(District Profile Sheets)

District Profile Sheets provided extensive information for the Mathematics Needs Assessment Project. A separate sheet is prepared for each district as part of the annual reporting process to the State Department of Education. All variables below are based on reports for the 1986-1987 school year.

It should be noted that the basic unit of observation for these variables is the district average or the county average. Thus, conclusions from these analyses are appropriate for the districts, but not necessarily for the school or the individual student. Further, whenever two districts are geograhically part of the same county, their demographic data for the county will be the same. In regression analyses, this problem raises the issue of statistical independence of observations. From a practical standpoint, these two issues are unavoidable, and should be considered when interpreting the variables and results of the present analysis.

Demographic Variables for the County

REGION: Each district is divided into regions according to their location (1=Delta, 2= Metropolitan, 3=Other).

TYPE: Each district is classified as either a county system (1), a consolidated system (2), or a separate system (3).

POPULATION: The population for each county was taken from the the District Profile Sheets.
(Mean=40462.42, Standard Deviation=43239.57)

DIPLOMA: The percent in the county holding a high school diploma was take from the District Profile Sheets.
(Mean=50.66, Standard Deviation=8.59)

NONWHITE: The percent nonwhite population for each county was taken from the District Profile Sheets.
(Mean=37.42, Standard Deviation=17.95)

COLLEGE: The percentage of adults with four years of college in each county was taken from the District Profile Sheets.
(Mean=10.77, Standard Deviation=4.26)

INCOME: The per capita income for each county was taken from the District Profile Sheets.
(Mean=4768.10, Standard Deviation=858.91)

POVERTY: The percentage of families below 1980 poverty level ($7,412 annual income) in each county was taken from the District Profile Sheets.
(Mean=21.04. Standard Deviation=7.01)

District Variables

ELEPERC: Total percentage in elementary grades for the district was obtained by dividing the number of students enrolled in K-6 by the total number of students in the district.
(Mean=56.23, Standard Deviation=2.90)

PERMIDDLE: Total percentage of students enrolled middle school grades was obtained by dividing the number of students enrolled in grade 7 and 8 by the total number of students in the district.
(Mean=15.11, Standard Deviation=1.80)

PERSECON: Total percentage of students enrolled high school was obtained by dividing the number of students enrolled in grade 9-12 by the total number of students in the district.
(Mean=27.17, Standard Deviation=3.33)

STUDENT: Total number of students in each district was taken from the District Profile Sheets.
(Mean=3135.13, Standard Deviation=3088.59)

VOCEDPER : Total percentage of students enrolled in vocational educational classes was obtained by dividing the number of students enrolled by total number of students in the district.
(Mean=22.52, Standard Deviation=8.37)

GIFTED: Total percentage of students enrolled in gifted programs in each district was divided by the total number of students in the district. This variable was eliminated from most analyses because District Profile Sheets often omitted or inaccurately reported percentages.
(Mean=3.06, Standard Deviation=2.21)

FREELUNC: The percentage of students receiving free lunch in each district was taken from the District Profile Sheet.
(Mean=72.76, Standard Deviation=18.09)

DROPOUT: The percentage of students who drop out of school in each district was taken from the District Profile Sheets.
(Mean=40.32, Standard Deviation=13.77)

STUTEARA : Student/Teacher ratio was obtained by dividing total number of students for each district by total number of teachers for each District Profile Sheets.
(Mean=19.51, Standard Deviation=2.58)

ELESAL: The average salary for elementary teachers in each district was taken from the District Profile Sheets.
(Mean=17814.14, Standard Deviation=1549.54)

SECONSAL: The average salary for secondary teachers in each district was taken from the District Profile Sheets.
(Mean=18068.21, Standard Deviation=2845.98)

ADVDEGRE: The percentage of teachers with advanced degrees in each district was taken from the District Profile Sheets. (Mean=39.44, Standard Deviation=10.93)

EXPOTO4: The percentage of teachers who have taught between zero and four years was obtained by dividing the number given on the District Profile Sheet for that category by the total number of teachers the district. (Mean=19.19, Standard Deviation=7.34)

EXP5TO9: The percentage of teachers who have taught between five years and nine years was obtained by dividing the number given on the District Profile Sheet for that category by the total number of teachers the district. (Mean=22.15, Standard Deviation=5.56)

EX10TO19: The percentage of teachers who have taught between ten years and nineteen years was obtained by dividing the number given on the District Profile Sheet for that category by the total number of teachers in the district. (Mean=39.95, Standard Deviation=8.23)

EP20PLUS: The percentage of teachers who have taught twenty or more years was obtained by dividing the number given on the District Profile Sheet for that category by the total number of teachers in the district. (Mean=23.10, Standard Deviation=7.63)

EMERCERT: The percentage of teachers on an emergency certificate was obtained by dividing the number reported on the District Profile Sheet for that category by the total number of teachers in the district. EMERCERT was omitted from many analyses because District Profile Sheets often failed to report this variable. (Mean=3.73, Standard Deviation=2.63)

OUTFIELD: The percentage of teachers who are teaching out of field was obtained by dividing the number given on the District Profile Sheet for that category by the total number of teachers in the district. OUTFIELD was omitted from many analyses because District Profile Sheets often failed to report this variable. (Mean=4.47, Standard Deviation=5.14)

PERPUPIL: The average current expenditure per pupil (instructional cost) was taken from the District Profile Sheets. (Mean=1565.87, Standard Deviation=1272.32)

ADVALORE: The district ad valorem (tax revenue) per pupil was taken from the District Profile Sheet. (Mean=343.46, Standard Deviation=272.93)

FEDPERCE: The percentage of district budget contributed by the Federal Government was taken from the District Profile Sheets.

(Mean=18.15, Standard Deviation=7.55)

STATEPER: The percentage of district budget contributed by the State was taken from the District Profile Sheets.
(Mean=58.14, Standard Deviation=8.00)

BASIC SKILLS ASSESSMENT PROGRAM DATA

BSAP3R: The percentage score on the BSAP 3R (third grade reading) for 1986-87 was taken from the District Profile Sheet.
(Mean=89.41, Standard Deviation=4.12)

BSAP3M: The percentage score on the BSAP 3M (third grade mathematics) for 1986-87 was taken from the District Profile Sheet.
(Mean=87.42, Standard Deviation=4.41)

BSAP3W: The percentage score on the BSAP 3W (third grade writing for 1986-87 was taken from the District Profile Sheet.
(Mean=137.68, Standard Deviation=630.42)

BSAP3C: The composite score on the BSAP 3 (third grade composite) for 1986-87 was taken from the District Profile Sheet.
(Mean=381.86, Standard Deviation=25.40)

BSAP5R: The percentage score on the BSAP 5R (fifth grade reading) for 1986-87 was taken from the District Profile Sheet.
(Mean=80.91, Standard Deviation=5.50)

BSAP5M: The percentage score on the BSAP 5M (fifth grade mathematics) for 1986-87 was taken from the District Profile Sheet.
(Mean=129.01, Standard Deviation=633.32)

BSAP5W: The percentage score on the BSAP 5W (fifth grade written communication) for 1986-87 was taken from the District Profile Sheet.
(Mean=79.45, Standard Deviation=4.61)

BSAP5C: The composite score on the BSAP 5C (fifth grade composite) was taken from the District Profile Sheet.
(Mean=938.85, Standard Deviation=4556.23)

BSAP8R: The percentage score on the BSAP 8R (eighth grade reading) was taken from the District Profile Sheet.
(Mean=73.11, Standard Deviation=5.73)

BSAP8M: The percentage score for the BSAP 8M (eighth grade mathematics) was taken from the District Profile Sheet.
(Mean=76.62, Standard Deviation=5.37)

BASP8W: The percentage score for the BSAP 8W (eighth grade written communication) was taken from the District Profile Sheet.
(Mean=83.09, Standard Deviation=3.59)

BSAP8C: The composite score for the eighth grade was taken from the District Profile Sheet.
(Mean=1049.85, Standard Deviation=2241.71)

BSAP11R: The percentage score for the BSAP 11R (eleventh grade reading) was taken from the District Profile Sheet.
(Mean=81.59, Standard Deviation=5.33)

BSAP11M: The percentage score for the BSAP 11M (eleventh grade math) was taken from the District Profile Sheet.
(Mean=76.73, Standard Deviation=5.26)

BSAP11W: The percentage score the BSAP 11W (eleventh grade written communications) was taken from the District Profile Sheet.
(Mean=86.02, Standard Deviation=3.73)

BSAP11C: The composite score for the eleventh grade was taken from the District Profile Sheet.
(Mean=1173.59, Standard Deviation=6.23)

STANFORD ACHIEVEMENT TEST DATA

STAKREAD: The percentage score for the Stanford Achievement Test in reading in grade K was taken from the District Profile Sheet.
(Mean=45.81, Standard Deviation=7.89)

STAKMATH: The percentage score for the Stanford Achievement Test in mathematics in grade K was taken from the District Profile Sheet.
(Mean=45.81, Standard Deviation=6.52)

STAKLAN: No scores were reported for the Stanford Achievement Test in Language Arts.

STAKENV: The percentage score for the Stanford Achievement Test in environment (grade K) was taken from the District Profile Sheet.
(Mean=49.14, Standard Deviation=8.02)

STA1READ: The percentage score for grade 1 on the Stanford Achievement Test in Reading was taken from the District Profile Sheet.
(Mean=48.49, Standard Deviation=2.70)

STA1MATH: The percentage score for grade 1 on the Stanford Achievement Test in Mathematics was taken from the District Profile Sheet.
(Mean=49.07, Standard Deviation=2.71)

STA1LANG: No scores were reported for grade 1 on the Stanford Achievement test in the Language Arts.

STA1ENV: The percentage score for grade 1 on the Stanford Achievement Test in Environment was taken from the District Profile Sheet.
(Mean=51.81, Standard Deviation=2.47)

STA4READ: The percentage score for grade 4 on the Stanford Achievement Test in reading was taken from the District Profile Sheet.
(Mean=47.14, Standard Deviation=7.30)

STA4MATH: The percentage score for grade 4 on the Stanford Achievement Test in Mathematics was taken from the District Profile Sheet.
(Mean=50.50, Standard Deviation=7.00)

STA4LANG: The percentage score for grade 4 on the Stanford Achievement Test in Language was taken from the District Profile Sheet.
(Mean=50.48, Standard Deviation=7.07)

STA4ENV: The percentage score for grade 4 on the Stanford Achievement Test in Environment was taken from the District Profile Sheet.
(Mean=49.35, Standard Deviation=6.63)

STA6READ: The percentage score for grade 6 on the Stanford Achievement Test in Reading was taken from the District Profile Sheet.
(Mean=44.95, Standard Deviation=7.27)

STA6MATH: The percentage score for grade 6 on the Stanford Achievement Test in Mathematics was taken from the District Profile Sheet.
(Mean=47.74, Standard Deviation=6.09)

STA6LANG: The percentage score for grade 6 on the Stanford Achievement Test in Language was taken from the District Profile Sheet.
(Mean=49.99, Standard Deviation=6.33)

STA6ENV: There were no scores reported for grade 6 on Environment from the Stanford Achievement Test.

FUNCTIONAL LITERACY EXAM DATA

FLEREAD: The percentage score for the Functional Literacy Exam in Reading was taken from the District Profile Sheet.
(Mean=82.00, Standard Deviation=5.19)

FLEMATH: The percentage score for the Functional Literacy Exam in Mathematics was taken from the District Profile Sheet.

(Mean=74.46, Standard Deviation=6.79)

FLEWRIT: The percentage score for the Functional Literacy Exam in Written Communications was taken from the District Profile Sheet.
(Mean=112.94, Standard Deviation=298.99)

FLECOMP: The Composite Score for the Functional Literacy Exam was taken from the District Profile Sheet.
(Mean=762.16, Standard Deviation=32.76)

FLEFAIL: The percent of students failing at least one section on the Functional Literacy Exam was taken from the District Profile Sheet.
(Mean=63.58, Standard Deviation=424.55)

GOTOCOLL: The percent of students in each district who go to college was obtained by dividing the number of graduating seniors in the district entering senior college, junior college, technical college, or business college as reported on the District Profile Sheet. Many districts miscomputed their percentages and this variable is not included in most analysis.